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United States Department of Agriculture, DIVISION OF ENTOMOLOGY.

HOW TO CONTROL THE SAN JOSE SCALE.

THE SAN JOSE SCALE A PERMANENT FACTOR IN FRUIT GROWING.

The San Jose scale is so widely disseminated and has become so firmly established in the principal deciduous fruit regions of this country that its extermination is now, in most cases, out of the question. In the main, therefore, the San Jose scale must be recognized as a permanent factor to be regularly dealt with as are other insect evils or the fungous diseases of plants.

Extermination is possible only where the scale is detected at the very outset on new or recently planted nursery stock or, at least, before any considerable chance of spread has been afforded. It is true that by the greatest care in the introduction of nursery stock the San Jose scale may be kept out of districts now free from it for years, perhaps, and one is warranted, therefore, in adopting every precaution to avoid introducing this scale and even to attempt extermination wherever the conditions are reasonably favorable. There is only one certain method of exterminating the scale, and that is in digging up and burning all infested trees. This is an heroic remedy and is advised only under the conditions of very recent introduction of nursery stock—in other words, where the scale is discovered within a few months after the purchase of the infested trees. If the scale has passed an entire breeding season in an orchard, it will have spread much more widely than any inspection will indicate and, very likely, will have gained a footing on wild and ornamental plants, other than fruit trees, from which it will reintroduce itself into neighboring orchards or into new plantings, however thorough may have been the attempts to eradicate it.

THE SAN JOSE SCALE CAN BE CONTROLLED.

While, therefore, one is undoubtedly justified in asserting that the San Jose scale is to be a permanency, it by no means follows that the profitable growth of deciduous fruits is seriously menaced on this account. The experience in California, covering many years, has abundantly demonstrated that this scale insect can be controlled, and

the more recent experience in the East points indubitably to the same conclusion. In other words, by proper repressive and remedial treatment, the value of which has been demonstrated by much practical experience, an orchard can be protected from serious injury and kept in a good paying condition so far as influenced by the San Jose scale.

In view of the above, it is certainly very unwise and wasteful to dig up and burn a large portion of an orchard because it is infested with this scale insect, especially since the replanted stock, even if clean when purchased, would, with little doubt, be in the same condition of infestation in a very short time.

One of the main objects of this circular, therefore, is to emphasize the importance and value of honest efforts to control this insect for the great majority of districts where it has established itself, rather than efforts at extermination, which will prove successful rarely, at best, and will always be accompanied with great immediate loss. The other principal object is to designate briefly the means of controlling this scale insect which experience has shown to be of practical value.

THE DIFFERENT MEANS OF CONTROLLING THE SAN JOSE SCALE.

In California, where this scale first occurred, the one remedy for it is in spraying with the lime, salt, and sulphur wash. This wash is very effective, and its use is possible in all climates similar to those of the Pacific coast. In the East, the moister climate and the more frequent rainfalls at and subsequent to the time when treatments have to be made render this wash ineffective, and distinct methods of treatment have been found to be necessary. The methods of control for the East are, in the order of their importance, as follows: (1) The soap treatment; (2) treatment with pure kerosene; (3) treatment with crude petroleum; (4) treatment with mechanical mixtures of either of the last two oils with water. In the main, these are all winter treatments and are made at any time when the trees are in a dormant, leafless condition. The treatments enumerated are all for trees in the orchard. Nursery stock badly enough infested to require such treatment is best destroyed. For the general disinfection of nursery stock the hydrocyanic-acid-gas treatment is the standard and only satisfactory means.

The soap treatment.—Whale oil or fish oil soap, preferably made with potash lye, is dissolved in water by boiling at the rate of 2 pounds of soap to the gallon of water. If applied hot and on a comparatively warm day in winter, it can be easily put on trees with an ordinary spray pump. On a very cold day, or with a cold solution, the mixture will clog the pump and difficulty will be experienced in getting it on the trees. Trees should be thoroughly coated with this

soap wash. Pear and apple trees may be sprayed at any time during the winter. Peach and plum trees are best sprayed in the spring, shortly before the buds swell. If sprayed in midwinter or earlier, the soap solution seems to prevent the development of the fruit buds, and a loss of fruit for one year is apt to be experienced, the trees leafing out and growing, however, perhaps more vigorously on this account. The soap treatment is perfectly safe for all kinds of trees, and is very effective against the scale. With large trees, or badly infested trees, preliminary to treatment it is desirable with this as well as other applications to prune them back very rigorously. This results in an economy of spray and makes much more thorough and effective work possible. The soap can be secured in large quantities at from $3\frac{1}{2}$ cents to 4 cents a pound, making the mixture cost, as applied to the trees, from 7 cents to 8 cents a gallon. The success of the soap treatment is largely influenced by the quality of the soap used. Many brands are on the market, mostly made with soda lye. A potash soap should be insisted on and one that does not contain more than 30 per cent of water. The soda soap washes are apt to be gelatinous when cold and difficult or impossible to spray except when kept at a very high temperature.

Kerosene treatment.—This consists in spraying the trees with ordinary illuminating oil (coal oil or kerosene). The application is made at any time during the winter, preferably in the latter part, and by means of a spray pump making a fine mist spray. The application should be attended with the greatest care, merely enough spray being put on the plant to moisten the trunk and branches without causing the oil to flow down the trunk and collect about the base. With the use of this substance it must be constantly borne in mind that careless or excessive application of the oil will be very apt to kill the treated plant. The application should be made on a bright, dry day, so that the oil will evaporate as quickly as possible. On a moist, cloudy day the evaporation is slow, and injury to the plant is more apt to result. If the kerosene treatment be adopted, therefore, it must be with a full appreciation of the fact that the death of the tree may follow. This oil has been used, however, a great many times and very extensively without any consequent injury of any kind. On the other hand, its careless use has frequently killed many valuable trees. Its advantages are its availability and its cheapness, kerosene spreading very rapidly and much less of it being required to wet the tree than of a soap and water spray. Pure kerosene is more apt to be injurious to peach and plum than to pear and apple trees, and the treatment of the former as with the soap wash should be deferred until spring. With young trees especially, it is well to mound up about the trunk a few inches of earth to catch the down-flow of oil, removing the oil-soaked earth immediately after treatment.

The crude-petroleum treatment.—Crude petroleum is used in exactly the same way as is the common illuminating oil referred to above. It is claimed to have an advantage over kerosene in that, as it contains a very large percentage of the heavy oils and paraffin, it does not penetrate the bark so readily, and, on the other hand, only the light oils evaporate, leaving a coating of the heavy oils on the bark, which remains in evidence for months and prevents any young scale which may have escaped from the individuals that were not reached by the spray from getting a foothold. Crude petroleum comes in a great many different forms, depending upon the locality, and very little experience has been had to determine just what brand is most desirable for use. The very heavy brands of crude oil are not to be recommended. The same cautions and warnings apply to the crude as to the refined oil.

The oil-water treatment.—Various pump manufacturers have now placed on the market spraying machines which mechanically mix kerosene or crude petroleum with water in the act of spraying. The proportion of kerosene can be regulated so that any desirable percentage of oil can be thrown out with the water. A 10-per-cent-strength kerosene can be used for a summer spray on trees where the San Jose scale is multiplying rapidly and it is not desirable to let it go unchecked until the time for the winter treatment. The winter treatment with the water-kerosene sprays may be made at a strength of 20 per cent of the oil. Applications of the oil-water spray should be attended with the same precautions as with the pure oil, and there is even somewhat greater risk, owing to the natural tendency one has to apply the dilute mixture much more freely than the pure oil. The application should be merely enough to wet the bark and should not, to any extent, at least, run down the trunk. The collection of water and oil about the trunk is just as dangerous to the tree as the pure oil.

In the use of the oil sprays noted above, one who has not had experience with them is advised to make some careful preliminary tests to fully master the process, preferably waiting two or three weeks to determine the results before entering on the general treatment of the orchard. It is well also, with the oil-water mixtures, to test the pump from time to time, spraying into a glass jar or bottle to determine by actual measurement whether the percentage of oil and water is being properly maintained.

FUMIGATION OF NURSERY STOCK.

All nursery stock which is under the least suspicion of contamination with the San Jose scale should be fumigated; and it is perhaps worth while to fumigate in any case to give the utmost assurance

of safety to the purchaser. The hydrocyanic-acid-gas fumigation is the one to use. This gas is generated by combining potassium cyanide, sulphuric acid, and water. The proportions of the chemicals are as follows: Refined potassium cyanide (98 per cent), 1 ounce; commercial sulphuric acid, 1 ounce; water, 3 fluid ounces—to every 100 cubic feet of space in the fumigating room or house. The latter should be as near air-tight as possible and provided with means of ventilation above and at the side, operated from without, so that the poisonous gases can be allowed to escape without the necessity of anyone entering the chamber. The generator of the gas may be any glazed earthenware vessel of one or two gallons capacity, and should be placed on the floor of the fumigating room and the water and acid necessary to generate the gas added to it. The cyanide should be added last, preferably in lumps the size of a walnut. Promptly after adding the cyanide the room should be vacated and the door made fast. The treatment should continue forty minutes. It must be borne in mind that the gas is extremely poisonous, and under no circumstances must be inhaled. The gas treatment is effective against the scale on growing trees in the orchard also; but the difficulty and expense of the treatment, except for nursery stock, makes it prohibitive in the case of deciduous fruits.

THE LIME, SULPHUR, AND SALT WASH.

This is the invariable remedy for the San Jose scale in California and much of the Pacific coast, and it is, under the conditions of climate obtaining in that region, undoubtedly very effective. Early experience with this wash in the East threw doubt on its efficiency as an insecticide under the climatic conditions prevailing throughout the eastern half of the United States. Some later experiments, however, have shown that wherever the weather conditions happen to be very favorable, duplicating, in a measure, the conditions on the Pacific coast, this wash is effective in the East also. Unfortunately, the weather conditions can not be relied on, and, therefore, its use in the East is not recommended. But if a considerable period (10 days or two weeks, at least) of dry weather could be assured after the treatment, it would probably give very satisfactory results when properly made and applied. It is a winter application and is applied in January or February, or at any time prior to spring growth. It may be prepared after the following formula: Unslaked lime, 30 pounds; sulphur, 20 pounds; salt, 15 pounds. Place all together in a barrel with 30 or 40 gallons of water and boil with steam for three or four hours. For use, the mixture should be diluted to make 60 gallons of wash, and may be preferably applied at a high temperature. It may be made in smaller quantities by boiling over a fire,

using the same proportion of ingredients. This wash is applied nearly every year, or as often as the San Jose scale develops in any considerable numbers. It has the advantage of leaving a limy coating on the trees, which acts as a deterrent to the young scale lice, and where it is not washed by rains retains its value as an insecticide coating for some time, remaining in evidence on the trees for several months.

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Approved:

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